

W. B. Butler

SOME DISEASES OF NURSERY STOCK.

Wm. T. Cook

NEW JERSEY

AGRICULTURAL

Experiment Stations

CIRCULAR 35

NEW JERSEY

AGRICULTURAL EXPERIMENT STATIONS

CIRCULAR 35

Some Diseases of Nursery Stock.*

The nursery and orchard industries are among the most important of the agricultural interests of the State, and so far as the local trade is concerned are in a great measure dependent upon each other. Therefore, this publication dealing with certain pests of both nursery and orchards is intended for both nurseryman and orchardist, but deals primarily with those diseases which are likely to be carried on nursery stock.

The responsibility for the carrying of these pests from place to place and their propagation rests on both nurseryman and orchardist. Many nurserymen use the greatest precautions known to the trade to insure healthy plants while others are careless and indifferent. On the other side of the question it must be said that many buyers of nursery stock are frequently careless and indifferent and willing to accept any kind of a plant provided it can be purchased a few cents cheaper than strictly healthy vigorous stock. The campaign for the control of orchard pests must be made by both nurseryman and orchardist.

This publication does not attempt to discuss or even mention all the plant diseases common to the nursery and orchard, but only the most serious ones which are likely to be carried on the nursery stock and which should be carefully guarded against by both nurseryman and practical grower.

* Prepared by Mel. T. Cook, Ph.D., Plant Pathologist, New Jersey Experiment Station.

Crown Gall and Hairy Root.

Crown gall (Fig. 1 and 2) is one of the most important diseases of fruit trees and many other plants, but unfortunately its importance is not fully appreciated by either nurserymen or fruit growers. The galls, which are also known as root galls or root knots, are most common at or just below the surface of the ground and on the roots, but frequently occur on the stems. They are more or less spherical, with irregular or roughened surfaces. Some are hard and others soft, but they are all due to the same cause. Although the disease has

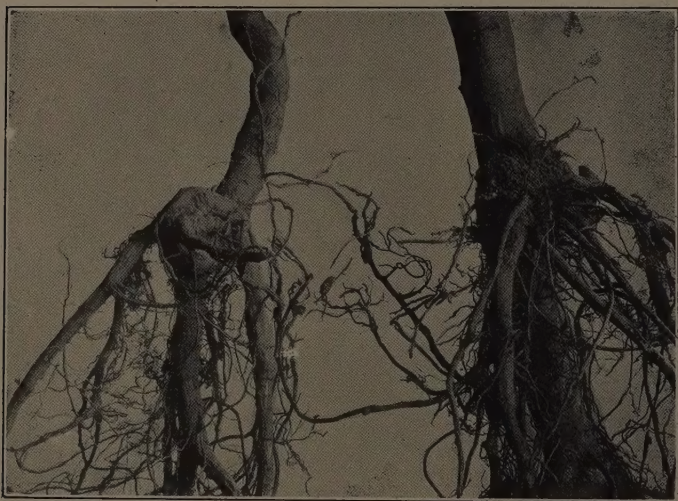


FIG. 1. NURSERY APPLE STOCK

Callous on the left. Crown Gall at point of union on the right

been known for a number of years, there were no American publications concerning it until 1892, and the cause was not known until 1907 when Smith and Townsend of the United States Department of Agriculture proved it to be a bacterial disease. However, it was well known that the disease could be communicated from tree to tree in various ways. Among others, Dr. Halsted of New Jersey had published proof of its contagious character as early as 1897.

Recent studies have also demonstrated that the disease is not localized at the points where the galls occur, but that strands of diseased tissue extend for considerable distances through the roots and stems and that new galls are formed at various points along its course. This fact demonstrates the impracticability of combating this disease

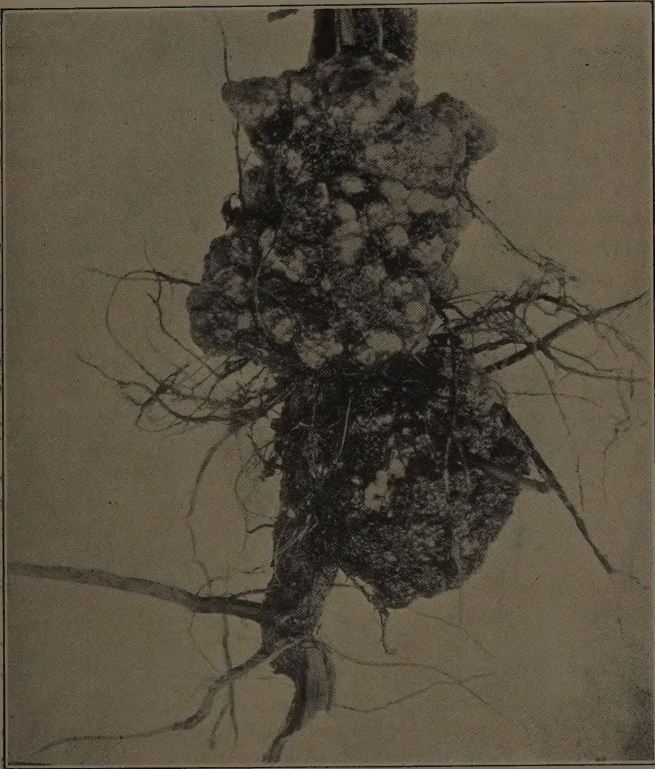


FIG. 2. CROWN GALL ON RED RASPBERRY

by cutting out those parts which show galls, as practiced by some nurserymen and growers. It is practically impossible to estimate the losses due to this disease, for it undoubtedly varies in different locali-

ties and on different plants. There is great difference of opinion among scientists, nurserymen and growers concerning the importance of the disease. Diseased trees will frequently grow, make a fine healthy appearance and produce fruit; while in other cases the disease is without doubt the cause of reduced crops, dwarfed growths and frequently death. The disease is probably less serious on apple trees than on some other fruits. It appears to be more destructive on peaches than on apples. It is very destructive to bush berries, especially red raspberries, and in some parts of this country has caused this industry to be abandoned. The organism (*Bacterium tumefaciens*) which causes the disease will live in the soil for a number of years, and the fact that it will live on such a large variety of plants makes its complete eradication practically impossible.

It has been called a "nursery disease" because of its prevalence on nursery stock, and without doubt this has been an important source of its distribution; but nurserymen cannot be held entirely responsible for its prevalence in certain localities, its wide distribution and the heavy losses which it has caused.

Nurserymen should use the greatest care in selection of both seedlings and scions. Rough, knotty, warty, hairy, or otherwise irregular seedlings and stock should be burned. Growers should also use care in selecting and planting stock. Although we cannot say at this time that it is the cause of heavy losses in apple growing, we can say that the planting of trees affected with the disease is very poor practice. Orchards or vineyards should not be set on land which has recently been used for the growing of bush berries or other crops on which the disease is prevalent. Bush berries and other crops which are subject to the disease should not be used as inter-row crops in young orchards. The writer has seen peach orchards which were seriously injured as a result of planting in old red raspberry fields and of using red raspberries as inter-row crops.

Hairy root (Fig. 3) appears to be due to the same organism as the crown gall. The diseased trees have a dwarfed root system and frequently produce masses of small fibrous roots among which galls are often found. A form of this disease also occurs on trunk and branches, causing knots which are smooth when young but which become warty with age. When placed under ground, they produce masses of fibrous roots. Scions from diseased trees will transmit

the disease. The same precaution should be used with this form of the disease as with the more typical crown gall.

Galls are frequently due to other causes. We are all familiar with the galls on the roots of clover, cowpeas and other legumes which are due to nitrogen-fixing bacteria, and therefore improvers of the

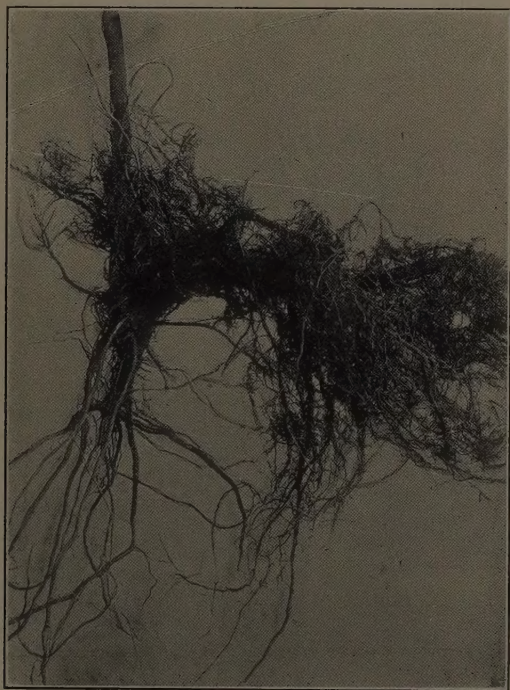


FIG. 3. HAIRY ROOT ON APPLE.

soil. They are restricted to legumes. However, the crown gall has been found on alfalfa and certain clovers.

Galls are also caused by insects. Those which are of the most importance to the fruit growers are the *Phylloxera vastatrix* of the grape and *Schizoneura lanigera*, or woolly aphis, of the apple. The

insects which cause these and other galls may also assist in scattering the crown-gall disease.

Root galls are also caused by small microscopical worms which are known as *nematodes*. It is frequently difficult to distinguish these galls, without a microscope, from the true crown galls.

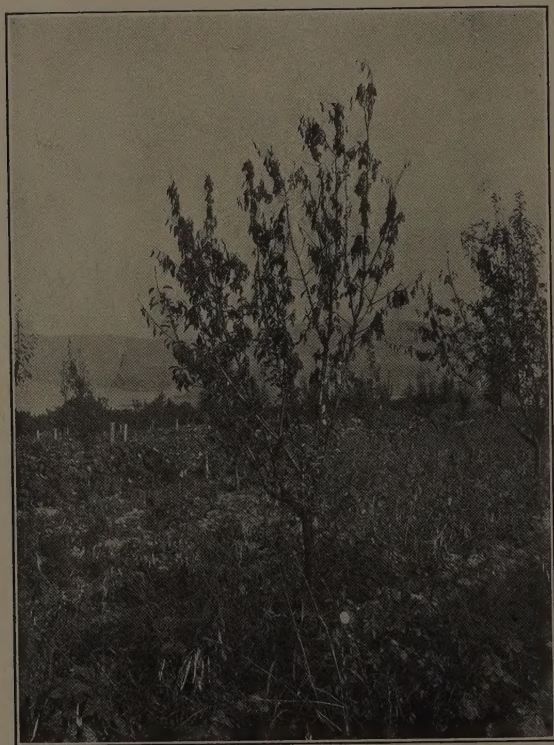


FIG 4. PEAR TREE AFFECTED WITH FIRE BLIGHT

(After Whetzel & Stewart in Bul. 272, Cornell Agricultural Exp. Station)

Galls are also frequently produced as a result of too tight or otherwise improper wrapping of the grafts. The new grafts are also points of infection from which true crown galls sometimes arise. It

is sometimes difficult to distinguish galls due to graft wrappings and galls due to graft infections.

Fire Blight on the Pear and Apple.

This is generally recognized as an American disease of the pear, apple, quince and related plants (Fig. 4). Its original hosts were probably the wild crab-apples and hawthorns of eastern North America. Our knowledge of it dates from 1870, when it was first observed in New York. It is now widely distributed throughout



FIG. 5. PEAR TREE AFFECTED WITH FIRE BLIGHT

(After Whetzel & Stewart in Bul. 272, Cornell Agricultural Exp. Station)

the United States and Canada, but so far as we know does not occur in other parts of the world.

The disease appears in four recognizable forms:

(1) The *blossom blight*, which appears soon after blossoming, killing the blossoms and young leaf tufts and working its way down into the fruit spurs. This form of the disease is most common in the nursery on the quince.

(2) The *twig blight* (Fig. 5), which is the most conspicuous and most generally recognized. The twigs blacken and the leaves turn brown and then black as though scorched by fire or killed by frost. These dead leaves cling to the shoot far into the winter, after the leaves from healthy parts have fallen. The diseased twigs frequently show small drops of a white, sticky substance which becomes yellow and finally black. The *twig blight* is the most common form of this disease in the nursery.



FIG. 6. PEAR BLIGHT CANKER SHOWING THE EXUDING MILKY DROPS.
(After Stewart in Bul. 329, Cornell Agricultural Experiment Station)

(3) The *fruit blight* usually originates from blossom infection, travels slowly back along the petiole of the diseased flower and thence out along the petioles of the young fruits which it causes to die, blacken and shrivel. It may also attack the fruit directly, probably gaining admission through slight wounds; such fruits are usually inclined to be covered with a sticky substance.

(4) The *body blight* (Fig. 6), occurs on twigs, branches and trunk and may extend to the roots. It appears as well defined, discolored

areas. This may originate by the disease working down from the outer diseased twigs or more frequently through diseased water sprouts. These cankers sometimes girdle the tree, causing its death; they are sometimes confused with winter injury.

The cause of the disease was a mystery for many years, but in 1878 Professor T. J. Burrill of the University of Illinois demonstrated it to be due to bacteria (*Bacillus amylovorus* (Burr) De Toni.) The bacteria live throughout the winter in some of the cankers and diseased twigs, multiply rapidly in the spring, and spread into the surrounding healthy tissues. They are to be found in the sticky white exudation previously referred to. This exudation is very attractive to insects, which become more or less smeared with it and are largely responsible for its transfer to the blossoms and young shoots. It is also transmitted on the pruning tools.

It is much more severe on soft, rapidly growing stock and of much less importance on the old or on hard growths. It is much more severe on some varieties than on others, the Bartlett pear and the Yellow Transparent apple being among the most susceptible varieties.

Spraying is of little or no value as a control but the disease can be held in check in the orchard by the following practices:

1. Winter prune and burn all diseased twigs, being careful to cut well back of the disease. These twigs can be recognized by the fact that the leaves usually cling to them after the leaves have fallen from the healthy twigs.

2. Cut out the canker and burn. Paint the wound with corrosive sublimate (1 part in 1,000 parts of water) or with 5% formaldehyde solutions, which can be obtained at any drug store. When dry, paint with white lead paint or coal tar.

3. During the summer cut out and burn the blighted tips as soon as possible. This may be impracticable in large orchards when the disease is exceptionally severe.

4. Keep the water sprouts and young spurs rubbed from the trunk and large branches. When they become infected the disease works in and causes the body blight cankers.

5. Do not over-prune the trees. Develop open or spreading crotches.

6. Do not over-fertilize. Avoid rich, nitrogenous fertilizers. Phosphoric acid is valuable; it tends to harden the new growths.

7. Remove or treat the neighboring wild crab, hawthorn and other trees which carry the disease.

8. The pruning knife should be frequently dipped in 5% formalin to destroy such germs as may cling to it.

9. Nurserymen should eradicate it so far as possible from all stock. The grower should not set a tree showing any sign whatever of the disease.

Apple Scab.

This is a fungus (*Venturia inaequalis*) disease, attacking first, leaf and twig. It is most conspicuous on the fruit where it first appears as peculiar green spots. (Fig. 7.) The skin on these spots



FIG. 7. APPLE AFFECTED WITH SCAB

(After Wallace, Cornell Agricultural Exp. Station. Bulletin 335)

breaks, exposing the fungus which becomes black. The spots enlarge and the centers become rusty. The diseased fruits are more or less irregular in shape and when the disease is severe the affected fruits frequently crack. On the leaves (Fig. 8) and twigs, the fungus forms a velvety coat varying from olive green to black. The leaf form is very common in the nurseries and the disease may be distributed on nursery stock. In the orchard, the disease is carried from year to year on the dead leaves.

The disease can be controlled by spraying with Bordeaux mixture or self-boiled lime sulphur just before the blossoms open and just after the petals fall.

Pear Scab.

This is a fungus (*V. pyrina*) disease very similar to the apple scab and can be controlled in the same manner.

Black Rot of the Apple and Quince.

This disease is quite common in both nursery and orchard. It is a fungus (*Sphaeropsis malorum*) disease attacking fruit, branch

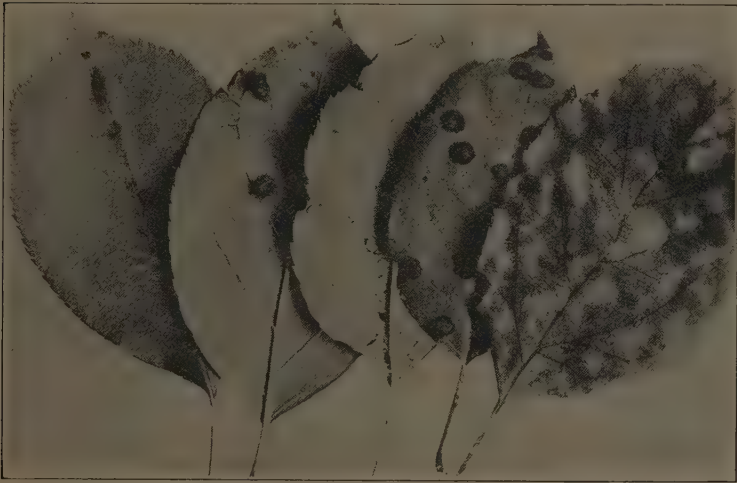


FIG. 8. SCAB ON APPLE LEAVES

(After Wallace. Cornell Agricultural Exp. Station. Bulletin 335)

and leaves. On the fruit it causes dark or black rotten areas covered with minute projections from which the spores emerge. On the branches, it produces rough dark cankers which frequently girdle the infected part, causing its death. It also kills the twigs, causing them to have an appearance very similar to that produced by the fire blight but distinguished from it by the numerous small black elevations. The twig form of the disease is very common

on nursery stock. It also causes a characteristic leaf spot (Fig. 9), which is common in both nursery and orchard.

The cankers should be cut out and burned and the orchard or nursery sprayed in the usual manner. *Never set diseased trees.*

Peach Yellows and Little Peach.

These diseases are the cause of greater losses in peach crops than all other diseases combined. They are similar in character and, although the subject of much study, their cause remains a mystery.

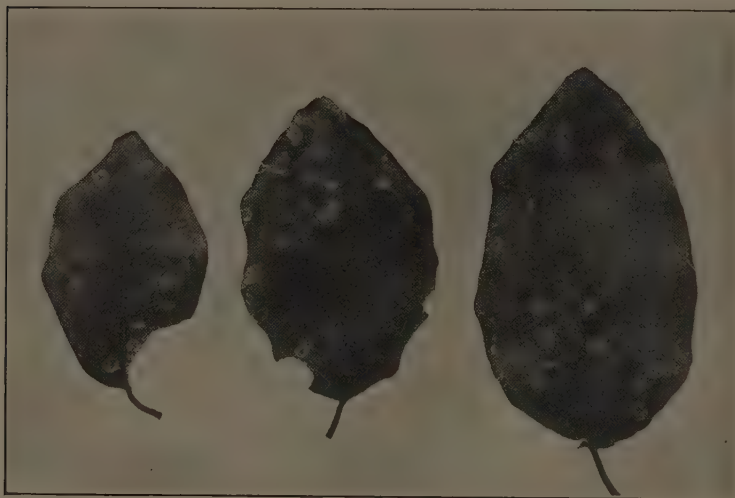


FIG. 9. BLACK ROT ON THE LEAVES OF THE QUINCE

However, it has been demonstrated that they can be controlled provided the nurseryman and grower follow the methods to which we shall refer.

Peach Yellows.

The best known of these diseases is the peach yellows, which was first noticed about 1791 in the Delaware river valley. It is now widely distributed throughout a considerable part of the United States and at times has caused practically a complete destruction of

commercial peach growing in many places. The rise of this pest and the possibilities of its being controlled are demonstrated by the following figures. In one county in Michigan the number of peach trees in 1874 was estimated at 654,000. The ravages of yellows reduced this number to 42,863 in 1890. The control of the disease led to a revival of the peach industry and in 1900 there were 923,288 trees.

The disease is not always easy to detect, especially in its early stages and in young trees. In bearing trees the symptoms are (a)

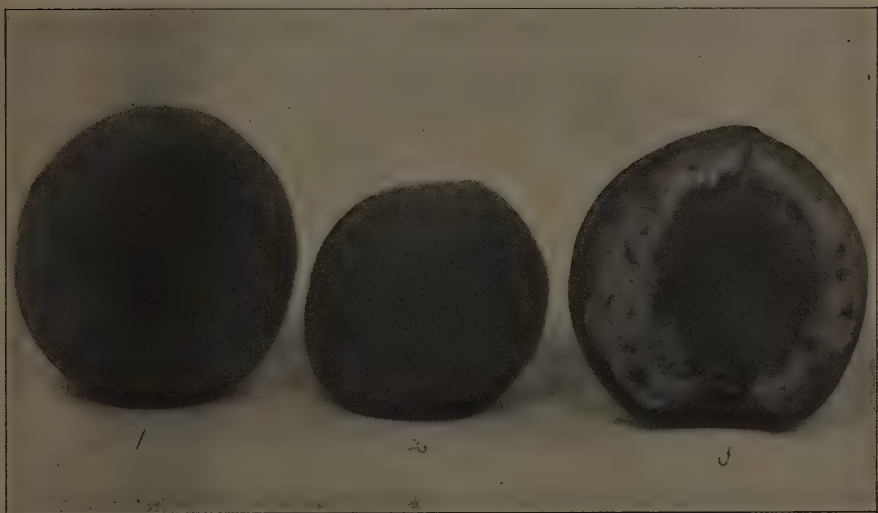


FIG. 10

Nos. 1 and 3 illustrate premature peaches from yellow trees. No. 2 is a specimen of little peach. Note the red spotted effect upon the surface of No. 1 and the flesh of No. 3. (After Blake, Bul. 226, N. J. Agr. Exp. Station)

premature ripening of the fruit (Fig. 10), (b) a willowy growth of new shoots upon the trunk or main branches (Fig. 11), and (c) discoloration of the foliage. The *premature ripening* may occur before either of the other symptoms, and such fruit always shows a red spotting or blotching over the surface or through the flesh. It is usually watery and insipid and sometimes quite bitter. Prematuring



FIG. II. A PEACH TREE IN THE LAST STAGES OF YELLOW'S
(After Blake, Bulletin 226, N. J. Agricultural Experiment Station)

may also be due to girdling by borers and other causes which can always be determined by careful examination. The so-called *willowing* is very easily recognized and is familiar to most peach growers. It occurs as slender, sometimes clustered, yellowish-green shoots on the trunk and lower branches. The leaves on these shoots are small, narrow and also greenish-yellow. The foliage of the diseased trees is frequently of a yellowish-green color, but if supplied with an abundance of nitrogenous fertilizer may not be very conspicuous. The disease may be noticeable in a part of the tree only, while the other part may appear perfectly healthy. However, the apparently healthy part is *not* healthy and in due time will show the true character of the disease.

Although the cause of peach yellows has not been determined it is well known that the disease can be transmitted from tree to tree by budding and otherwise. The fact that the disease can be easily transmitted in this manner makes nursery stock a dangerous source of distribution unless the greatest care is used in the selection of bud wood. There is considerable evidence to indicate that the disease has been frequently distributed on nursery stock. The appearance of the disease during the first, second or third summer on trees from certain nurseries while trees of the same variety from other nurseries were perfectly healthy indicates that the trees must have been diseased before they left the nursery. Prof. M. A. Blake of our New Jersey Agricultural Experiment Station describes the disease on young trees as follows: "If the leaves of one branch of such a tree begin to turn a yellowish-green or have a reddish, rusty green appearance and roll from the edges, it indicates a checking of the growth of the branch. If no insect or mechanical injury has occurred to the branch it strongly indicates yellows. The leaves upon such a branch ripen early and fall while the remainder of the tree retains most of its foliage. The fruit buds will be larger and further advanced upon the affected part and the bark will have a riper appearance with noticeably larger lenticles. This change in the behavior of any part of a well cultivated young peach tree does not usually occur until August in New Jersey and sometimes not until September" (Fig. 12). A young tree may also first show symptoms of disease by a drooping of the foliage toward the branches and trunk, together with a change in the color of the foliage from a dark



FIG. 12. A TWO-YEAR-OLD PEACH TREE SHOWING UNMISTAKABLE

SIGNS OF YELLOWS

(After Blake, Bulletin 226, N. J. Agricultural Experiment Station)

green to a light or even yellowish green. The affected leaves are also of a decidedly stiff and ripened texture as compared to normal leaves. These symptoms are quite characteristic and can be readily distinguished when once known.

There is no cure for yellows other than the cutting and burning of the diseased trees. The diseased trees should not touch the healthy trees. New trees can be planted in the same place as the old ones; the disease does not persist in the soil and is not transmitted through it.

Little Peach.

This disease is of comparatively recent origin, is similar to yellows, and its cause is also unknown. It is as widely distributed as yellows and equally as destructive. The fruit is small, ripens late, is inferior in quality and frequently insipid and watery. The leaves are frequently lighter green than normal leaves and may be yellowish-green and are often rolled and drooping. This disease can probably be distributed through nursery stock and, therefore, great care should be used in the selection of bud wood and young trees. Diseased trees must be treated in the same manner as for yellows.

Similar Diseases on Other Plants.

A number of other related plants, such as plum, cherry, apricot and raspberry, are affected with similar diseases, which are probably due to the same causes, although we have no positive proof. Yellows of plum and little plum are becoming more and more abundant and are demanding more and more attention from persons interested in the fruit industries.

Treatments.

The treatments for "yellows" and "little peach" are the same. Nurserymen and all others who make a business of budding trees should use the greatest care possible in selecting both seedlings and bud wood. The fact that the disease is difficult to detect in nursery stock makes this all the more important. Fruit growers and nurserymen are not familiar enough with the appearance of trees in the early stages of these diseases. Bud wood from the apparently healthy part of a slightly diseased tree will carry the disease. When once introduced into a nursery, it is readily transmitted by the common practice of

budding from row to row. In this way the most honest and careful nurseryman may unknowingly distribute the disease. The presence of the disease on a number of trees of a single variety and from the same nursery during the first, second or third year is cause for suspicion that the disease came from the nursery.

The disease can be transmitted from tree to tree and from orchard to orchard, and therefore every diseased tree is a menace to the community. All diseased trees should be cut and burned. Do not drag them through the orchard, for the disease may be communicated to other trees by contact. This work should be carried on as a community movement and as a matter of public welfare; otherwise the work of the individual will be slow and difficult. The disease is not transmitted through the soil and, therefore, new trees can be placed in the same holes from which the diseased ones were removed.

The need for co-operation on the part of both nurserymen and fruit growers in checking and eradicating these diseases is urgent and would result in great benefit to the entire State.

Leaf Curl of the Peach.

The disease has been known for nearly 100 years and is widely distributed throughout the peach growing districts of the world. It is usually most severe when the spring is rather cool and damp. The curled, distorted condition of the foliage is familiar to all peach growers, but many fail to appreciate that it also attacks the blossoms and young fruit and the young twigs. When very severe it causes the foliage to fall and thus makes it necessary for the tree to put out a second crop of leaves.

The disease is due to a fungus (*Exoascus deformans* (Berk) Fuckel) which grows within the tissues, coming to the surfaces of the affected parts to produce its fruit or spores. The fungus lives in a resting condition in the tissues and rough bark and crevices of the twigs until the following spring, when it grows and infects the new growth of the tree.

It can be readily controlled by a thorough spraying with copper sulphate or lime-sulfur in the spring just before the opening of the buds. The latter treatment is the better, since it is also a scalecide. This early spring treatment of the peach should never be omitted.

Black Knot.

This fungus (*Plowrightia morbosa*) disease of the plums and cherries is well known to all nurserymen and growers. It appears as warty knots (Fig. 13), which turn black and which are frequently very abundant and destructive. They should be cut out and burned during the fall or winter and the trees sprayed with lime-sulphur in the spring before the buds swell.

The Bark Disease or Blight of the Chestnut.

This is one of the most destructive plant diseases that has ever appeared in this country. It is caused by a fungus (*Endothea*



FIG. 13. BLACK KNOT ON PLUM

parasitica) growing in and killing the cambium layer and surrounding tissues (Fig. 14). It appears as cankers which completely girdle the branches and trunk, killing all parts beyond the point of infection. On the young smooth bark these cankers appear as discolored, sunken areas, but are not so readily recognized on the old rough bark. On the old cankers, the bark becomes rough and cracked; yellow, orange or reddish-brown fruiting bodies about the size of a pin head are produced on the surface. The disease spreads rapidly and several advance infec-

tions have been traced to nursery stock. There is no known method of controlling this disease in the forest but it can be held in check on individual trees and small plantings by cutting out and burning the infected parts and painting the wound with coal tar or white lead paint. Our nurserymen are urged to discontinue handling chestnut



FIG. 14. SEEDLING CHESTNUT KILLED BY THE BARK DISEASE

stock and the public advised to discontinue planting chestnuts for the present.

Anthraxnose of Berries.

This is the most common disease known on blackberries, raspberries and dew-berries. It is a fungus (*Gloeosporium venetum*) disease, appearing first as small purplish spots, which become grayish in the centers with slightly raised, purplish

border. As they increase in size they tend to unite and form irregular blotches. In severe cases the stems become scaly and sometimes crack. This disease interferes with the normal activities of the plant,



FIG. 15. DOUBLE BLOSSOM AND NORMAL LEAF BUDS OF
THE LUCRETIA SOON AFTER OPENING

causing a small prematurely ripened fruit and when severe kills the entire plant.

The old diseased canes should be cut out and burned in the late summer or fall and the plants sprayed with Bordeaux mixture or

lime sulphur. They should also be sprayed with Bordeaux mixture two or three times at intervals of two weeks in the spring. It is doubtful if spraying will be profitable on large plantings, but the grower should insist on setting nothing but healthy plants.

Gooseberries and currants. These fruits are subject to certain leaf and cane diseases which seriously injure or destroy them. Several of these diseases are very common in this State both in the nursery and on the farm.

Double Blossom of the Dewberry.

This disease is very common on the Lucretia, Black Diamond or Wonder Blackberry and frequently occurs on other varieties. It is caused by a fungus (*Fusarium rubi*), which causes the leaf buds (Fig. 15) to produce a number of shoots, forming the well-known witch's broom. The flowers are also very much distorted and produce a few worthless berries. Some growers suppose these diseased blossoms to be staminate or male flowers, but such is not the case. The fungus reaches its maturity in these distorted blossoms and the spores fall upon the new buds which are being formed for the following year. A very satisfactory and economical treatment is the handpicking of these diseased buds in the spring soon after they open. If this is kept up from year to year the disease will be of little importance, but if allowed to run without treatment will reduce the life of the plants.

Minor Diseases.

There are numerous leaf spots and minor diseases which cannot be discussed in this circular. Under favorable conditions they frequently become abundant and occasionally quite serious. They give nursery stock an unsightly appearance and should be controlled by spraying so far as it is possible to do so without incurring too great expense. Root diseases are sometimes the cause of quite serious troubles on plants growing in the crowded conditions of the nursery and should be guarded against so far as possible by careful rotations.

Left Over Stock.

The observations of our inspectors indicate that the left over fruit stock, which is frequently heeled in, is the source of many diseases. Nurserymen are urged to reset such stock and give it proper care or to destroy it.